MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2016/2017

EEL 3146 – ELECTRIC POWER UTILIZATION AND INSTALLATION

(LE)

09 MARCH 2017
2:30 PM – 4:30PM
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of 12 pages including cover page with 5 Questions only.

2. Answer ALL questions. All questions carry equal marks and the distributions of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided.

Question 1

a) Explain the four roles of Energy Commission in Malaysia.

[5 marks]

b) Code of Practice 54 (COP 54) as given below is one of the requirements for electrical installation in buildings. Explain the need for 10mA RCD.

MS1979 : 2007

4.8.9 COP 54, RCD for special places

RCDs with rated residual operating current not exceeding 10 mA shall be installed in the following instances:

a) in places of public entertainment;

b) where the floor is likely to be wet; and

c) for the protection of electric water heaters.

[5 marks]

c) Sketch a single line diagram for an electrical installation in a domestic system. Types of loads are as listed below. Following components are available in the distribution board.

[10 marks]

1 x 2P 40A Main Circuit Breaker
4 x 1P 20 A MCBs
2 x 1P 10 A MCBs
1 x 2P 40A RCD, 50 mA
1 x 2P 20A RCD, 10 mA

Loads
4 × Switch Socket Outlets
11× Downlights
1× 1500 W, Water Heater
1× 1 hp Air Conditioner

Continued....

Question 2

a) A LRT train is scheduled to travel from KJ10 station to KJ11 station within 4 minutes (including stop time at KJ10 for 30 sec). The retardation is 0.8 km/hr/sec. The train was designed for maximum speed of 80 km/hr. Determine the scheduled speed and minimum acceleration for the LRT train.

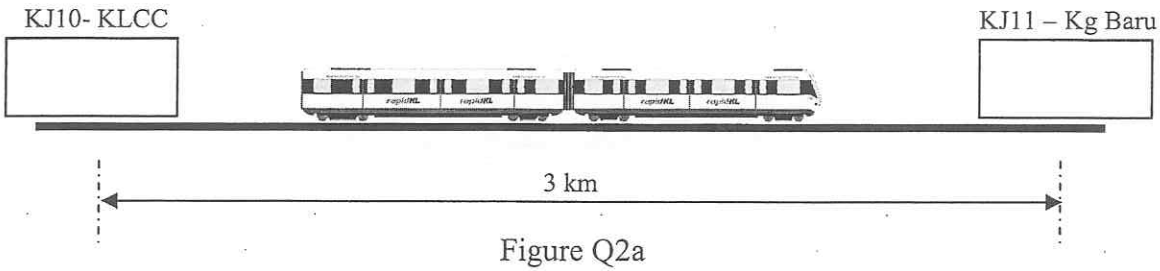

Figure Q2a

[12 Marks]

b) Figure Q2b shows a typical speed-time curve for a train system. Sketch speed-time curves for urban and sub-urban train system. State two differences between the both train systems.

[8 Marks]

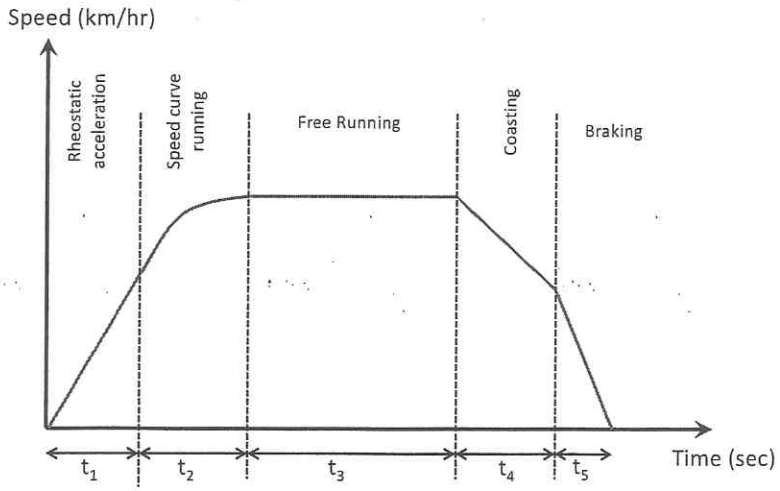

Figure Q2b

Continued...

Question 3

A single phase load is installed using 2.5 mm^2 single core PVC non-sheathed cables enclosed in PVC conduit. The circuit is protected using a 20A Type C MCB. Calculate the suitable size for the circuit protective conductor (CPC). Cable length for live conductor and CPC are 20 m and 25 m respectively. Verify your answer with the adiabatic equation.

Given, the fault earth loop impedance of the supply is 1.5 Ω and expected disconnection time is 5 s. The time/current characteristic of MCB is given in Appendix A. Value for K for adiabatic equation can be found in a table given in Appendix B.

[20 Marks]

Table Q3 - Resistance per meter of copper conductors at 20°C for calculation of R1 + R2

Conductor cross-sectional area (mm²)	*Resistance per meter run (m ohms / m)*
1.0	18.1
1.5	12.10
2.5	7.41
4.0	4.61
6.0	3.08
10.0	1.83
16.0	1.15
25.0	0.727
Note that to allow for the increase in resistance with increased temperature under fault conditions the values of {Table 1} must be multiplied by 1.2 for p.v.c. insulated cables	

Continued...

Question 4

A 15m (L) x 20 m (W) lounge requires efficiency lighting design.

a) Determine the minimum illuminance for this lounge. Refer to table in Appendix C.

[2 Marks]

b) Calculate the number of lamps required to obtain the minimum illuminance. Assuming the maintenance factor is 0.85 and that coefficient of utilization is 0.7. Calculate the numbers for both lamps given in appendix D and E.

[10 Marks]

Please select the following model of lamps

CFL - FLE45HLX/T5/B22/827

LED - LED 27/T8 1500MM/840/220-240V BX1/20

c) Determine the efficacy for each of the lamps.

[4 Marks]

d) Calculate the minimum W/m^2 for each installations (for both lamps).

[4 Marks]

Continued...

Question 5

a) Discuss two methods used to control the temperature in a resistance heater.

[4 Marks]

b) What are the differences between direct and indirect resistance heating.

[8 Marks]

c) A high frequency induction furnace takes 10 minutes to melt 1.8 kg of an aluminum material. The input to the furnace is 5 kW and initial temperature 15°C. Estimate the efficiency of the furnace. Given the following details.

Specific heat of aluminium = 880 J $kg^{-1}°C^{-1}$.
Melting point of steel = 660 ° C.
Latent heat of fusion of steel = 32 k J / kg

(Given 1J = 2.78 x 10^{-7} kWhr)

[8 Marks]

Continued...

Appendix A: Time/Current Characteristics for Type C Circuit Breaker

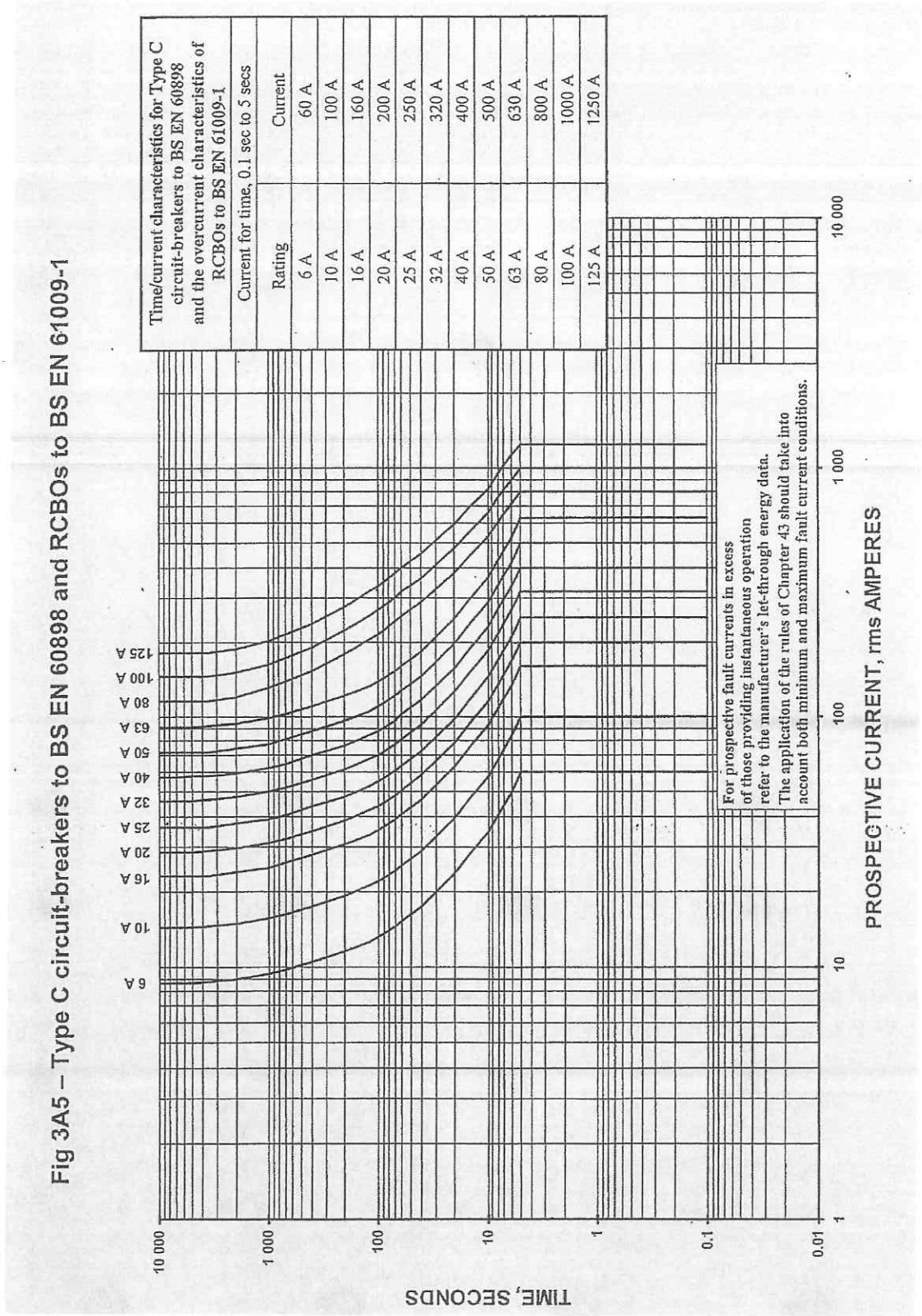

Fig 3A5 – Type C circuit-breakers to BS EN 60898 and RCBOs to BS EN 61009-1

Continued…

Appendix B: Table 43.1 for Values of K

TABLE 43.1 –
Values of k for common materials, for calculation of the effects of fault current for disconnection times up to 5 seconds

Conductor insulation	Thermoplastic				Thermosetting		Mineral insulated	
	90 °C		70 °C		90 °C	60 °C	Thermoplastic sheath	Bare (unsheathed)
Conductor cross-sectional area	≤ 300 mm²	> 300 mm²	≤ 300 mm²	> 300 mm²				
Initial temperature	90 °C		70 °C		90 °C	60 °C	70 °C	105 °C
Final temperature	160 °C	140 °C	160 °C	140 °C	250 °C	200 °C	160 °C	250 °C
Copper conductor	k = 100	k = 86	k = 115	k = 103	k = 143	k = 141	k = 115	k = 135/115[a]
Aluminium conductor	k = 66	k = 57	k = 76	k = 68	k = 94	k = 93		
Tin soldered joints in copper conductors	k = 100	k = 86	k = 115	k = 103	k = 100	k = 122		

Continued…

Appendix C: MS 1525:2014

Table 10. Recommended average illuminance levels

Task and Applications	Illuminance (Lux)
a) Lighting for infrequently used area:	
- Minimum service illuminance	20
- Interior walkway and car-park	100
- Hotel bedroom	100
- Lift interior	100
- Corridor, passageways, stairs	100
- Escalator, travellator	150
- Entrance and exit	100
- Staff changing room, locker and cleaner room, cloak room, lavatories, stores.	100
- Entrance hall, lobbies, waiting room	100
- Inquiry desk	300
- Gate house	200
b) Lighting for working interiors	
- Infrequent reading and writing	200
- General offices, shops and stores, reading and writing	300 - 400
- Drawing office	300 - 400
- Restroom	150
- Restaurant, canteen, cafeteria	200
- Kitchen	150 - 300
- Lounge	150
- Bathroom	150
- Toilet	100
- Bedroom	100
- Class room, library	300 - 500
- Shop/supermarket/department store	200 - 750
- Museum and gallery	300
c) Localised lighting for exacting task	
- Proof reading	500
- Exacting drawing	1000
- Detailed and precise work	2000

Continued…

Appendix D: Compact Fluorescent Lamps

GE
Lighting

WORLDWIDE PARTNER

DATA SHEET

Spiral T5
6,000 hours MEA

Compact Fluorescent Lamps Integrated
45W and 60W

Product information

The T5 Spiral 6,000 hours lamps are high light output energy saver. The eco-friendly alternative for high wattage incandescent bulbs, ensuring excellent light quality and reliable energy savings.

Basic data

MIC GE SKU	MIC TU SKU	PRC GE* SKU**	PRC TU SKU**	Rated Power* [W]	Volts w[V]	Cap	Product Description	Rated Lumen [lm]	CCT [K]	CRI [Ra]	Rated Life* [h]	Length [mm]	Diameter [mm]	Pack Qty	Inca Watt Equivalent	EEC	Pallet Quantity
95194	528812	–	–	45	220-240V	E27	FLE45HLX/T5/E27/827	2900	2700K	80	6000	209	78	10	200	B	440
95193	528811	95975	528927	45	220-240V	E27	FLE45HLX/T5/E27/865	2900	6500K	80	6000	209	78	10	200	B	440
95192	528810	–	–	60	220-240V	E27	FLE60HLX/T5/E27/827	3600	2700K	80	6000	216	78	10	225	B	440
95191	528809	95974	528926	60	220-240V	E27	FLE60HLX/T5/E27/865	3600	6500K	80	6000	216	78	10	225	B	440
–	93012722	–	–	45	220-240V	B22	FLE45HLX/T5/B22/865	2900	6500K	80	6000	208	78	10	200	B	440
–	93012721	–	–	45	220-240V	B22	FLE45HLX/T5/B22/827	2900	2700K	80	6000	208	78	10	200	B	440
–	93012666	–	–	60	220-240V	B22	FLE60HLX/T5/B22/865	3600	6500K	80	6000	215	78	10	225	B	440
–	93012667	–	–	60	220-240V	B22	FLE60HLX/T5/B22/827	3600	2700K	80	6000	215	78	10	225	B	440

* Rated wattage, life and lumen are equivalent to nominal values, which are indicated on product packaging.
** Printed on packaging "PRC" means that the country of origin is China (Made in People's Republic of China). Countries of Egypt, Kenya, Oman, Russian Federation, United Arab Emirates and Yemen by regulation allow only „MIC" marked product to import. Please consult GE Customer Service or GE Sales Contact on applicable SKUs before order entry.

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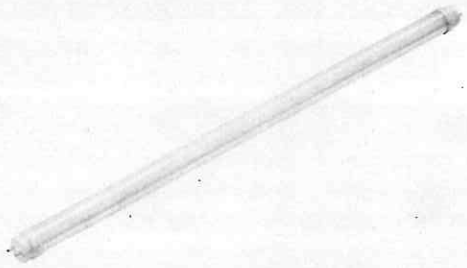
Appendix E: LED Lamps

GE
Lighting

WORLDWIDE PARTNER

LED T8 tubular lamps



DATA SHEET

Product information

The GE LED T8 range offers safe, reliable and affordable energy saving alternatives to standard Fluorescent T8 lamps.

Available in 2'/60cm, 4'/120cm and 5'/150cm lengths, GE LED T8s can be quickly fitted as a replacement into luminaires operating on electro-magnetic control gear or on electronic gear with a simple re-wire (for further details see intallation guide).

Features

- Energy saving up to 60% (on mains connection versus T8 fluorescent lamps on electro-magnetic gear)
- High light output up to 3000Lm
- Instant-on light
- Long lifetime: up to 50,000 hours L70
- High Power Factor: 0.9
- Wide 130° light distribution
- Compatible with existing installations

Specification summary

Rated Wattage	Length (mm)	CCT (Kelvin)	CCT Steps	Product Description	Rated Luminous flux (lm)	Life B50 (hrs)	CRI (Ra)	Energy Efficiency Class	Pack Qty (pcs)	Product Code
LED T8 Energy saving range - G13 base										
9	600	4000	6	LED 9/T8 600MM/840/220-240V BX1/30	750	50 000	80	A+	30	90450
9	600	6500	6	LED 9/T8 600MM/865/220-240V BX1/30	800	50 000	80	A+	30	90451
18	1200	4000	6	LED 18/T8 1200MM/840/220-240V BX1/30	1550	50 000	80	A+	30	90455
18	1200	6500	6	LED 18/T8 1200MM/865/220-240V BX1/30	1650	50 000	80	A+	30	90456
LED T8 High output range - G13 base										
12	600	4000	6	LED 12/T8 600MM/840/220-240V BX1/30	1050	40 000	80	A+	30	90453
12	600	6500	6	LED 12/T8 600MM/865/220-240V BX1/30	1100	40 000	80	A+	30	90454
23	1200	4000	6	LED 23/T8 1200MM/840/220-240V BX1/30	2150	40 000	80	A+	30	90457
23	1200	6500	6	LED 23/T8 1200MM/865/220-240V BX1/30	2250	40 000	80	A+	30	90458
27	1500	4000	6	LED 27/T8 1500MM/840/220-240V BX1/20	3000	40 000	80	A+	20	93010222
27	1500	6500	6	LED 27/T8 1500MM/865/220-240V BX1/20	3000	40 000	80	A+	20	93010223

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Examination Formula Sheet EEL3146

Lighting and Illumination

Inverse-square law

$$E = \frac{I}{d^2},\ E_x = \frac{I\cos^3\theta}{d^2}$$

Electric Traction

Trapezoidal Approximation

$$D = \frac{\left[2TV_m - V_m^2\left(\frac{1}{\alpha}+\frac{1}{\beta}\right)\right]}{7200}$$

Quadrilateral Approximation

$$D = \frac{\left[(V_1+V_2)T - V_1V_2\left(\frac{1}{\alpha}+\frac{1}{\beta}\right)\right]}{7200}$$

$$V_2 = \frac{V_1 - \beta_c\left(T - \frac{V_1}{\alpha}\right)}{1-\frac{\beta_c}{\beta}}$$

Net tractive effort for propulsion of train

$$F_t = 277.8M_e\alpha + Mr \pm 98MG$$

Total specific energy output

$$E_T = \frac{0.010726V_m^2}{D}\left(\frac{M_e}{M}\right) + 0.2778r\frac{D'}{D} \pm 27.25G\frac{D'}{D}\quad Whr/Ton\,km$$

Electric Heating

Heat transferred by radiation

$$Q = e\sigma A(\Delta T)^4$$

Where Q is the heat transferred by radiation, E is the emissivity of the system, σ is the constant of Stephan-Boltzmann (5.6697 x 10^-8 W/m^2.K^4), A is the area involved in the heat transfer by radiation, and $(\Delta T)^4$ is the difference of temperature between two systems to the fourth or higher power.

Earthing and Protection

Adiabatic equation

$$S = \frac{\sqrt{I_a^2 t}}{k}$$

End of paper